  UGC CARE Listed (Group -I) Journal Volume 11, Iss 11, 2022

RELATIONSHIP OF MATERNAL AND ENVIRONMENTAL VARIABLES WITH INFANTS' BIRTH WEIGHT

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ABSTRACT

Birth weight serves as a vital marker of newborn health, influencing long-term well-being. This study delves into the relationship between various maternal and environmental factors and infants' birth weight. By exploring these multifaceted influences, this research aims to contribute essential insights to prenatal care strategies and public health policies. A comprehensive literature review was conducted to identify relevant maternal variables (such as maternal age, nutrition, prenatal care, and maternal health status) and environmental variables. These variables were then analyzed concerning their impact on infants' birth weight using rigorous statistical methods. This study underscores the intricate relationship between maternal and environmental variables and infants' birth weight. The findings emphasize the critical need for targeted prenatal interventions aimed at improving maternal nutrition, mental well-being, and access to prenatal care. Addressing environmental factors, especially in disadvantaged communities, is crucial. By understanding and addressing these multifaceted influences, healthcare providers and policymakers can develop targeted strategies to enhance maternal and child health outcomes, promoting healthier birth weights and, consequently, better long-term health for infants.

Keywords: Maternal, Infants, Prenatal, Environmental, Birth weight, Health

INTRODUCTION

The birth weight of an infant is a critical indicator of their overall health and well-being. It is influenced by a multitude of factors, including maternal health, nutrition, socioeconomic status, and environmental conditions. Understanding the intricate relationship between maternal and environmental variables and infants' birth weight is essential for ensuring the health and developmental outcomes of newborns. This study delves into this complex interplay, aiming to uncover the various factors that contribute to infants' birth weight and shed light on actionable strategies for improving maternal and child health outcomes.

Birth weight is not merely a numerical value; it carries profound implications for an infant's health trajectory. Low birth weight, often associated with adverse maternal and environmental conditions, is linked to a higher risk of infant mortality, developmental delays, and chronic health conditions later in life. On the other hand, appropriate birth weight is indicative of a well-nourished, healthy newborn, setting the stage for optimal growth and development.

Numerous maternal factors significantly influence infants' birth weight. Maternal nutrition, both preconception and during pregnancy, plays a pivotal role. Adequate prenatal care, maternal age, maternal health conditions (such as gestational diabetes and hypertension), and maternal mental health are all vital factors that can impact fetal growth and birth weight. Understanding how these variables interact is crucial for crafting effective prenatal care strategies.

ISSN PRINT 2319 1775 Online 2320 7876
  UGC CARE Listed (Group -I) Journal Volume 11, Iss 11, 2022

Beyond maternal factors, the environment in which pregnant women live also contributes substantially to infants' birth weight. Socioeconomic status, access to healthcare facilities, exposure to environmental pollutants, and the availability of social support networks all play roles in shaping birth weight outcomes. Environmental stressors, such as air pollution and socioeconomic disparities, can negatively impact fetal development, leading to suboptimal birth weights.

LITERATURE REVIEW

Tyagi, Sarika et.al. (2017). Through a review of the existing literature, this research sought to demonstrate a connection between maternal nutritional condition and birth weight. More over two hundred papers on the topic were eliminated throughout the screening process for this study, and 101 were ultimately chosen for inclusion in the final report. Infant birth weight may be most reliably predicted by the mother's nutritional state. Many different things affect this connection. Birth weight is mostly determined by the mother's diet. The development and growth of a fetus depends on a wide variety of nutrients, both macro and micro. The birth weight of a baby is connected to the mother's micronutrient status throughout pregnancy. Low birth weight and unfavorable birth outcomes are linked to a mother's having a body mass index (BMI) below 18.5 before pregnancy. Low birth weight is most strongly associated with a family's socioeconomic position. Though it has no direct effect on birth weight, it does have an indirect effect on all the other factors that might contribute to a low birth weight. The mother's degree of education is also significant. Thus, mother nutritional status influences fetal development and birth weight more than any other component that may be biological, social, or demographic in nature.

Ringshaw, Jessica et.al. (2021). The health of both mother and child may be positively affected by proper prenatal and postnatal diet. This is an issue all around the world, but it is more pressing in LMICs because of the prevalence of low birth weight (LBW) and the prevalence of maternal malnutrition. Low birth weight has been linked to a variety of negative health, growth, and brain development consequences. Due to the lack of attention paid to maternal obesity and premature delivery in neuroimaging studies in high-income countries, we know far less about the effects of maternal nutrition and LBW on neurodevelopment. In LMICs, where there is a significant risk of food insecurity and around 43% of children under the age of 5 are at danger of not achieving their developmental potential, maternal nutrition may be crucial to understanding how LBW influences the child brain. Furthermore, it is vital, but less researched, to look at the effects of LBW in newborns who are small-for-gestational-age (SGA) because to intrauterine growth restriction (IUGR) in LMICs. Therefore, further neuroimaging studies are required to fully understand the interplay between maternal nutrition, low birth weight, and structural brain consequences. In order to maximize the developmental potential of children from LMICs, this should be acknowledged as a research priority to guide dietary treatments during pregnancy.

Akhtar, Naushaba et.al. (2021). I More over 15% of babies worldwide have a low birth weight, with 95.6% of them occurring in underdeveloped nations. The purpose of this study is to evaluate maternal nutrition throughout pregnancy by measuring maternal body mass index. The objective of this study is to determine whether there is a correlation between a mother's BMI during pregnancy and her baby's birth weight. Urban pregnant women (n=97) were the subjects of an observational research. The results showed that 41.24 percent of pregnant women had a body mass index less than or equal to 18.5 and that 50.8 percent had a body mass index greater than or equal to 18.5; 58.76 percent of pregnant women gave birth to babies weighing more than 2.5 kilograms. There was a strong correlation between mothers' BMIs in the first trimester of pregnancy and their kids' birth weights.

Dahake, Swati. (2019). Background Birth outcomes are affected by a pregnant woman's diet and nutritional state. To better understand the relationship between maternal diet, anthropometry, and nutrition-related co-morbidities and infant birth weight (IBW), we did a comprehensive scoping review of the current literature. The goals of this research were to (1) determine whether or not pregnant women are getting enough micronutrients, and (2) determine whether or not maternal variables (including anthropometry, diet, plasma glucose, and blood pressure) are associated with IBW. Methods The main papers were located using a comprehensive search of eleven databases: ProQuest, EBSCOhost, Scopus, Cochrane Library, Science Direct, Wiley Online Library, PubMed, Google Scholar, My Journal, Book SC, and Inter Library Loan with Medical Library Group. The abstracts and complete publications were evaluated for eligibility by three reviewers. Information on demographic characteristics, research procedures, and major results pertinent to the review's aims was gleaned. Following the PRISMA-ScR guidelines, seventeen papers published between 1972 and 2021 were included. Results Maternal calcium, iron, vitamin D, folic acid, and niacin intakes were below national standards, according to the studies. The birth weight of babies whose mothers ate more fruit was likewise higher. Maternal factors linked to fetal macrosomia included a high BMI before pregnancy, excessive GWG during pregnancy, and elevated blood sugar. Low gestational weight gain, use of sweets and condiments throughout pregnancy, and pre-pregnancy hypertension all contributed to a low-birth-weight infant. Conclusion Several causes of low birth weight were found in this analysis, including maternal diet, comorbidities, body mass index, and weight increase throughout pregnancy. This suggests that improving mother health and nutrition is important for the birth outcome.

Mohamed, Jan et.al. (2022). Nutritional status, maternal hemoglobin content, and anthropometric data were measured and correlated with newborn anthropometry in this cross-sectional descriptive research. Two hundred healthy pregnant women between the ages of 18 and 37, during gestational weeks 27 and 41, were enrolled in the research. Women who had gone to the tertiary center in Mumbai for their prenatal care and were now in labor were recruited in the research. Socio-demographic information, data about the pregnancy, and a record of the last 24 hours' worth of eating were gathered using a questionnaire that had already been prepared and field-tested. Trained workers assessed maternal and newborn anthropometry using defined methods. The hospital record included the newborn's birth weight, length, and hemoglobin levels both before and after delivery. The impact of maternal nutrition on infant health was analyzed using SPSS (version 16.0). If the p-value was less than 0.05, it was regarded to be significant. Maternal mean anthropometrics included a height of 153.13 10.39 cm, a postpartum weight of 57.02 11.57 kg, a postpartum body mass index of 24.29 3.54 kg/m 2, a pre-delivery hemoglobin concentration of 11.19 1.78 g/dL, and a post-delivery concentration of 9.97 1.68 g/dL. In spite of a mean birth weight of 2.770.50kg, 22.3% of newborns were considered to be of low birth weight (2.5kg). Length was 45.721.14cm, MUAC was 10.481.14cm, ponderal index was 2.880.43g/cm3, and MUAC/Head circumference was 0.310.03. Compared to women (27 years), women (28 years) were older (+2.46 years), heavier (both pre- and post-partum), and had a longer (both pre- and post-partum) interpregnancy gap (+1.3 years) and gravida (p0.05). Maternal factors such as height, weight, postpartum BMI, hemoglobin levels, gestational age, and dietary consumption (especially calories, protein, vitamin C, and calcium) were associated with birth outcomes. Birth outcomes are significantly influenced by maternal nutrition both before and throughout pregnancy, as well as maternal anthropometry, hemoglobin concentrations just

ISSN PRINT 2319 1775 Online 2320 7876

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before delivery, and gestational age. Therefore, it is important to pay attention to the nutrition of teenage girls via preconception counseling and nutrition education in order to improve pregnancy outcomes.

RESEARCH METHODOLOGY

Longitudinal Cohort Study: Adopt a longitudinal approach to track maternal variables (such as nutrition, prenatal care, maternal health conditions) and environmental variables (including socioeconomic status, pollution levels, access to healthcare) throughout pregnancy. This design allows for the observation of trends and changes over time, providing a comprehensive understanding of the variables' impact on infants' birth weight.

Participant Selection:

Participants: Recruit a diverse sample of pregnant women from various socioeconomic backgrounds and geographical locations. Include participants from urban and rural settings to capture a broad range of environmental influences. Collect demographic information, medical histories, and socioeconomic data.

Sample Size: Determine an adequate sample size based on power analysis to ensure statistical validity in the results.

Data Collection:

Maternal Variables: Conduct structured interviews and medical record reviews to gather data on maternal nutrition, prenatal care attendance, maternal health conditions (e.g., diabetes, hypertension), mental health status, and lifestyle factors (e.g., smoking, substance use).

Environmental Variables: Collaborate with environmental agencies to collect data on air and water quality, pollution levels, and neighborhood characteristics. Use geographic information systems (GIS) to assess the proximity of participants to healthcare facilities and green spaces.

Birth Weight Measurement: Record infants' birth weight immediately after delivery using calibrated scales, ensuring accuracy and consistency in measurements.

DATA ANALYSIS

Table 1 Environmental characteristics of the participants (N=340)

Variables	Categories	N	%
Primary fuel	Dirty fuel	114	33.7
	Clean fuel	225	66.3
Ventilation	No ventilation	234	69.1
	Ventilation	105	30.9

ISSN PRINT 2319 1775 Online 2320 7876

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Fans in living room	No fans	6	1.8
	Fans	334	98.2
Presence of dusty industry	Dusty industry	320	94.0
	No dusty industry	20	6.0
Type of industry	Brick	320	94.0
	Welding	1	0.4
	Others	19	5.6
Location of the house	Unclean surrounding	338	99.3
	Clean surrounding	2	0.7
Type of house	Independent	218	64.1
	Shared	105	31.0
	Apartment	16	4.8
House construction	Kutcha	36	10.7
	Pucca	304	89.3
Passive smoking	Present	50	14.6
	Absent	290	85.4

Because of differences in socioeconomic status and residential location, individuals experienced a wide range of environmental conditions (Table 1). Sixty-six percent of them utilized clean fuel for cooking at home, but 33 percent were using unclean fuel, putting their unborn children at risk. Of the 240 women who participated, only 30.9% (N=105) lived in homes with working ventilation, yet 98.2% of them had ceiling fans in their main living area. Ninety-four percent of the participants lived in an industrial area, and 99.3 percent of them reported living in a filthy environment, both of which pose serious risks to the health of the pregnant lady. 64.1% of people were housed in single-family detached homes, while 69.3% were housed in multi-family pucca homes. 14.6% of subjects reported being exposed to passive smoking.

Table 2 Clinical Profile of participants who delivered live babies (N=200)

Parameter	Minimum	Maximum	Mean	SD
Height (cm)	135.00	170.00	152.85	6.21
Weight (Kg)	28.00	91.00	52.42	10.11
Body Mass Index	13.90	36.90	22.43	4.08
Hemoglobin (g)	7.00	13.60	9.89	1.52
Birth Weight (g) of infant	1000	4900	2771.99	450.38

Table 2 displays the maternal and newborn anthropometrics, hemoglobin levels, and birth weights of women who have just given birth to healthy children. As a group, the women had a mean body mass index (BMI) of 22.43 (SD=4.08), a mean height (H) of 152.85 centimeters (cm), and a mean weight (kg) of 52.42 (kg). The average participant had a hemoglobin level of 9.89 g/dl (SD=1.52), and their kids weighed in at 2771.99 g (SD=450.38).

Table 3 Comparison between the clinical profile of participants and infants' birth weight (N=200)

Maternal Parameters	Birth weight categories	N	Mean	SD	F value	p-value
Height (cm)	Below 2500 g	40	152.44	6.76		
	2500 g and above	160	153.04	6.07	.990	.320
Weight (kg)	Below 2500 g	40	52.59	11.51		
	2500 g and above	160	52.40	9.77	.037	.847
BMI	Below 2500 g	40	22.64	4.70		
	2500 g and above	160	22.36	3.89	.490	.484
Hb (g)	Below 2500 g	40	9.58	1.43		
	2500 g and above	160	10.01	1.53	8.409	**.004****

The characteristics of mothers whose babies weighed more than or less than 2500 grams at birth are compared in Table 3. Women who gave birth to babies weighing more than 2500 g and those who gave birth to babies weighing less than 2500 g did not differ significantly in terms of height, weight, or body mass index; however, there was a statistically significant difference between the hemoglobin status of women who gave birth to babies weighing 2500 g and above and those who gave birth to babies weighing less than 2500 g. The association between maternal hemoglobin and infant birth weight is seen in the above table.

Table 4 Distribution of Pregnant women with nutritional intake >75% of the RDA (N=340)

Nutritional intake	RDA	>75% of RDA		< 75% of RDA	
		N	%	N	%
Energy (Kcal/day)	2250 (Sedentary)	14	4.25	3	0.88
	2580 (Moderate)	205	60.46	117	34.41
CHO (g/day)	562.5	91	26.9	248	73.1
Protein (g/day)	88	129	38.1	210	61.9
Fat (g/day)	30	308	90.6	32	9.4

Table 4 shows how pregnant women are distributed according to their dietary consumption. It was shown that moderately active women (60.5%) and inactive women (4.3%) consumed more than 75% of their daily caloric needs. Over 90% of them, in fact, took in more than 75% of the daily maximum for fat. When compared to the recommended intakes, however, 73.1% of them fell short on carbs and 61.9% on protein.

Table 5 Trimester-wise distribution of macronutrients intake by pregnant women (N=340)

Trimester (N)	Energy M (SD)	Carbohydrate M (SD)	Protein M (SD)	Fat M (SD)
1 (136)	2044.1 (732)	343.6 (126.1)	58.4 (23.1)	52.6 (26.9)
2 (146)	1783.9 (723.5)	297.2 (117.6)	53.6 (26.1)	45.7 (27.4)
3 (58)	2136.5 (696.6)	359.7 (130.7)	60.8 (20.3)	50.4 (20.9)

The average consumption of macronutrients by pregnant women is broken out per trimester in Table 5. Across all three trimesters of pregnancy, the average dietary energy intake of pregnant women was found to be below the dietary consumption recommendation of the National Institute of Nutrition. Similar patterns were seen in both mean carbohydrate and mean protein consumption. In all three trimesters, individuals reported eating more fat than is considered healthy.

ISSN PRINT 2319 1775 Online 2320 7876

 UGC CARE Listed (Group -I) Journal Volume 11, Iss 11, 2022

Table 6 Mean birth weight of neonates as compared to nutrient intake of the mother (N=200)

	LBW		NBW		P-value
	Mean	**SD**	**Mean**	**SD**	
Energy	2003.6	606	2129.3	615.6	0.044*
CHO	323.7	105.2	365.6	107.9	0.000***
Protein	58.1	19.8	64.4	16.3	0.000***
Fat	43.5	25.2	45.4	20.9	0.394

Table 6 provides the average birth weight of the infants in comparison to the maternal dietary consumption, as seen in Figures 4.15 and 4.16. The energy consumption of pregnant women whose babies were born at a healthy weight (2129.3 g) vs those whose babies were born at a low weight (2003.6 g) was significantly different. There was no statistically significant correlation between maternal fat consumption and infant birth weight.

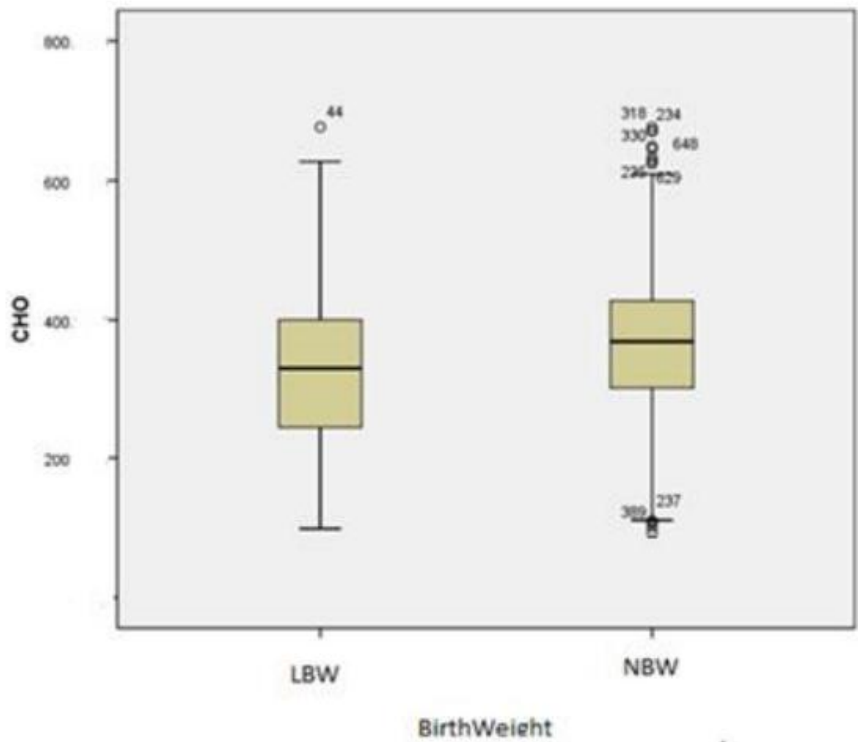

Figure 1 Association between CHO intake and birth weight

CONCLUSION

In examining the intricate interplay between maternal and environmental variables and their impact on infants' birth weight, this research has illuminated crucial insights that hold significant implications for maternal and child healthcare strategies, policy development, and public health interventions. The findings of this study underscore the complexity of factors influencing birth weight and provide valuable directions for improving maternal and child health outcomes. Maternal factors, including nutrition, prenatal care, maternal health conditions, and mental health, have been identified as pivotal determinants of infants' birth weight. Adequate prenatal care, coupled with proper maternal nutrition, emerges as a cornerstone for ensuring healthy birth weights. This emphasizes the importance of comprehensive maternal healthcare that addresses not only medical conditions but also mental well-being and nutritional support during pregnancy. In conclusion, the relationship between maternal and environmental variables and infants' birth weight is intricate and multifaceted. Addressing the complexities involved requires a concerted effort from healthcare providers, policymakers, and communities. By implementing targeted interventions that encompass maternal healthcare, social support, and environmental quality improvements, we can work towards ensuring healthier birth weights and brighter futures for newborns. This research serves as a foundation for evidence-based policies and practices that prioritize the well-being of both mothers and their infants, paving the way for a healthier and more equitable society.

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